Operation Manual

Thorlabs Instrumentation

PRO8000 (-4) / PRO800

Photo current module PDA8000

2012

THORLABS

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We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to come up to your expectations and develop our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

In the displays shown by the PRO8 you may find the name PROFILE.

PROFILE was the name of the manufacturer before it was acquired by Thorlabs and renamed to Thorlabs.

Thorlabs

This part of the instruction manual contains every specific information on how to operate the photo current module PDA8000. A general description is followed by explanations of how to operate the unit manually. You will also find every information about remote control via the IEEE 488 computer interface.

☝Attention☝

This manual contains "WARNINGS" and "ATTENTION" label in this form, to indicate dangers for persons or possible damage of equipment.

Please read these advises carefully!

NOTE

This manual also contains "NOTES" and "HINTS" written in this form.

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1 General description of the PDA8000

1.1 Safety

☝ Attention ☝

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

Before applying power to your PRO8000 (-4) / PRO800 system, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth contact of the socket outlet!
Improper grounding can cause electric shock with damages to your health or even death!

Modules may only be installed or removed with the mainframe switched off.

All modules must be fixed with all screws provided for this purpose.

Modules of the 8000 series must only be operated in the mainframe PRO8000, PRO8000-4 or PRO800.

All modules must only be operated with duly shielded connection cables.

Only with written consent from Thorlabs may changes to single components be carried out or components not supplied by Thorlabs be used.

This precision device is only dispatchable if duly packed into the complete original packaging including the plastic form parts. If necessary, ask for a replacement package.

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☝ Attention ☝

Semiconductor laser modules can deliver up to several 100mW of (maybe) invisible laser radiation!

When operated incorrectly, this can cause severe damage to your eyes and health!

Be sure to pay strict attention to the safety recommendations of the appropriate laser safety class!
This laser safety class is marked on your PRO8000 (-4) / PRO800 plug-in module or on your external laser source used.

☝ Attention ☝

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to EN 50 082-1.

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1.2 Features

- **Utmost precision**

  The single or dual channel photocurrent amplifier modules PDA8000 offer a maximum of precision and sensitivity. The polarity of the photodiode is nevertheless free selectable.

- **Different operating modes**

  The photodiode may either be operated photovoltaic or photoconductive by setting a bias voltage of 0 ... 10V.

- **7 measurement ranges**

  For a low noise measurement with 15 bit resolution plus sign there are seven measurement ranges from 10 nA to 10 mA. The lowest, still detectable current is about 0,1 pA (!)

- **Optical power measurement**

  Since the photocurrent amplifier modules can be calibrated by selecting the photodiode sensitivity η they can be used for precise optical power measurements after calibration.

- **Forward voltage measurement (optional)**

  Optionally it will be possible to measure the forward voltage of the photodiode with a selectable measurement current between 0.01 and 10 mA. (option PDA8000-FWD).

- **Extensive filtering**

  The mains filter installed in the mainframe and the careful shielding of the transformer, the microprocessor and the module itself will provide an excellent suppression of noise and ripple.

- **Selecting the reference ground**

  Additionally the reference ground for the measurements can be adapted to the measurement setup.

- **LabVIEW®- and LabWindows/CVI®-driver**

  For the PDA8000 *Thorlabs* supplies LabVIEW®- and LabWindows/CVI®-drivers for MS Windows 32.

  Please refer to our homepage for latest driver updates.

  http://www.thorlabs.com

1.3 Technical data

(All technical data are valid at 23 ± 5°C and 35 ±15% humidity)

Photocurrent amplifier module PDA8000-1(2)

General data

Photodiode current range	10 nA ... 10 mA[1)]
Resolution	16 bit
Polarity of photodiode	selectable
Setting range of bias voltage (can be switched off)	0.1 V ... 10 V
Setting range of the photodiode coefficient η	0.001 ... 5.000 A / W
Temperature coefficient	≤ 50 ppm/K
Input impedance	0Ω (virtual ground)
Operating temperature	0 … + 40°C
Storage temperature	- 40 … + 70°C

Forward voltage measurement for channel 1 (opt. PDA8000-FWD)

Measurement technique	2-wire technique
Measurement current	0.01 ... 10 mA (± 5%)
Measurement range U_{FWD}	0 ... 2 V[2)]
Resolution	0.3 mV
Accuracy	± 5 mV

Connectors

Photodiode	BNC

Measurement ranges

Current range	Resolution	Accuracy
10 mA	0.1 µA	± 0.025 % f.s.
1 mA	10 nA	± 0.025 % f.s.
100 µA	1 nA	± 0.025 % f.s.
10 µA	0.1 nA	± 0.025 % f.s.
1 µA	10 pA	± 0.025 % f.s.
100 nA	1 pA	± 0.250 % f.s.[3)]
10 nA	0.1 pA	± 0.800 % f.s.[3)]

[1] other ranges on request

[2] reduces to 0 ... 1 V for I_{FWD} > 8 mA

[3] higher accuracy can be reached by repeated measurements

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1.4 Operating elements at the front of the module

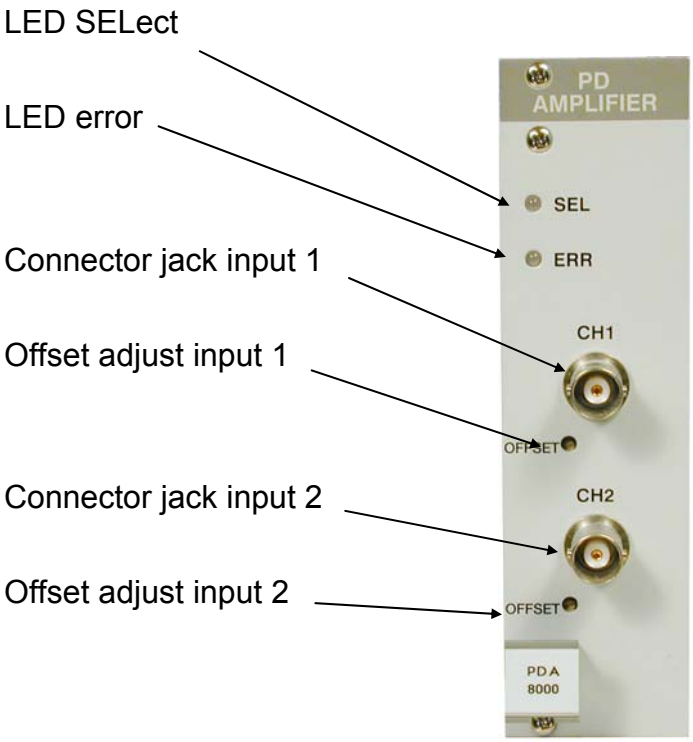

Figure 1 Operating elements on the PDA8000-2 front panel

1.5 Presettings

1.5.1 Offset adjustment

- Connect the photodiode and all other components of the complete system (the photodiode must be in total darkness).
- Switch on the PRO8000 (-4) / PRO800.
- Select 10 µA-range.

➔ (Refer to chapter 2.2.7, "Setting the measurement range" on page 12)

- Enter the channel menu to observe the photodiode current.
- Adjust the offset with the offset potentiometer of the corresponding channel to "zero".

➔ (Refer to chapter 1.4, "Operating elements at the front of the module" on page 6)

NOTE:

When using photodiodes with a dark current higher than 1 nA only the ground conductor of the photodiode is to be connected.

1.6 Connecting the photodiode

Photodiodes can be connected to the BNC jacks of an input with both polarities. The outer conductor of the BNC jack is always grounded.

Both polarity settings of the PDA8000 (AG = "**a**node **g**round" and CG = "**c**athode **g**round") can be used depending on how the photodiode is connected to the BNC jack.

If one of the connectors of the photodiode itself is connected to ground (e.g. as with many housed laser diodes) this ground connector has to be connected to the outer conductor of the BNC jack.

Only one of the polarity settings of the PDA8000 (AG or CG) will then be correct.

If in doubt, the correctly selected polarity yields a positive photo current on the display.

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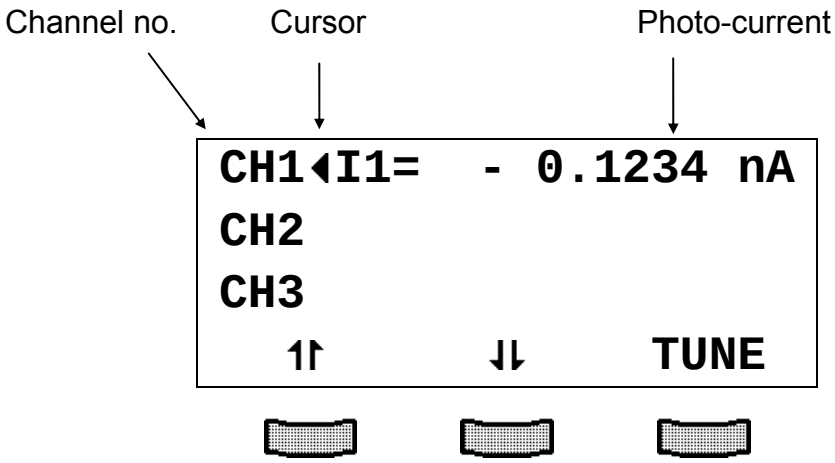
2 Operating the PDA8000

2.1 Functions in the main menu

2.1.1 Display

The main menu shows the channel number and the photo diode current measured at input 1



2.1.2 Selecting a module

Select a module for further input by setting the cursor to the channel number of the desired module.

Use the soft key 1↑ and 1↓ .

CH4◀

Pressing CHANNEL will lead to the channel menu

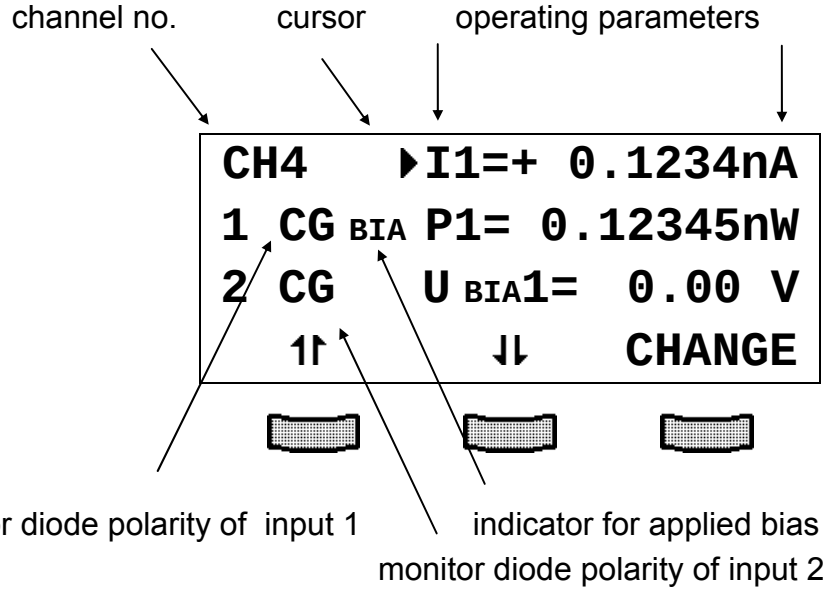
2.2 Functions in the channel menu

By pressing the key CHANNEL you enter the channel menu.

Pressing again CHANNEL or ESC will lead back to the main menu.

2.2.1 Display

In the channel menu all parameters of the selected module are shown:



Only three parameters can be shown at a time, so there is a scroll function. All parameters are sorted in a virtual list, which can be run through with the cursor:

```
I1=+ 0.1234nA
P1=  0.1234nW
UBIA1=  0.00 V
C1=1.12345A/W
BIA1 = OFF
RNG1 =10.00nA
POL1 = CG
Ifwd=1.1234mA
Ufwd=1.234 V
MEASURE Ifwd
I2=+ 0.1234nA
P2=  0.1234nW
...
```

```
...
UBIA2=  0.00 V
C2=1.12345A/W
BIA2 = OFF
RNG2 =10.00nA
POL2 = CG
```

If you use the PDA8000-FWD:

```
Ifwd= 3.000mA
Ufwd= 1.551 V
MEASURE  Ifwd
```

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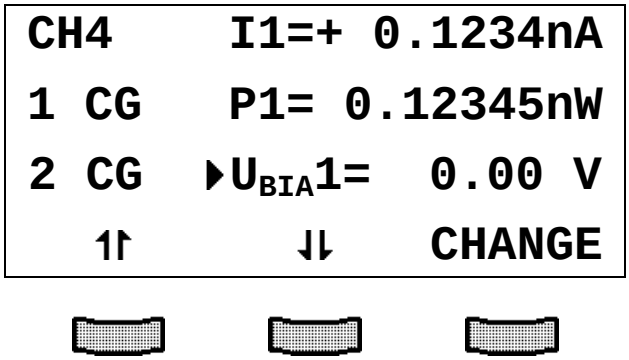
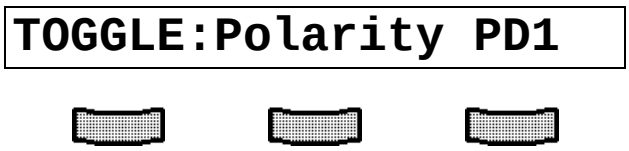
2.2.2 Changing parameters

To set or change a numerical parameter in the channel menu the respective line is selected with the cursor:

Example: $U_{BIA}1$ is to be changed:



Pressing the key (**CHANGE**), activates the tuning knob enabling the selected parameter to be changed. If the selected parameter is a switch parameter (i.e. the polarity of the photo diode) the function of the soft key will change:



Pressing the right soft key will toggle the polarity.

Pressing ESC terminates the input.

NOTE

Some parameters can not be changed, as they are measurement values (i.e. the photo diode current) or may not be changed during bias voltage switched on. In these cases access is denied indicated by a long beep.

2.2.3 Selecting the polarity of the photo diode

To change the polarity of the photo diode select

POL1 = for input 1

POL2 = for input 2

in the channel menu of the module. It then can be changed to the desired polarity.

➔ (Refer to chapter 2.2.2, "Changing parameters" on page 10)

NOTE

If the selected polarity of the photodiode is wrong the measured photodiode current will be displayed negative. Trying to set a bias voltage or to measure the forward voltage (opt. PDA8000-FWD) will yield an error message.

2.2.4 Calibrating the photo diode

If the displayed optical power shall be calibrated, the correct sensitivity η of the photo diode must be entered.

If for example η is 0.5 A/W this can be done in the channel menu entering the value

C1=0.5000A/W for input 1

C2=0.5000A/W for input 2

The default value of η is 0.1000 A/W. It is valid without specific confirmation.

2.2.5 Setting the bias voltage

Each input can operate with a bias voltage in the range of 0 ... 10 V.

If for example the photo diode shall work with 3.000 V bias voltage this can be entered in the channel menu :

U_{BIA}1= 3.00 V for input 1

U_{BIA}2= 3.00 V for input 2

➔ (Refer to chapter 2.2.2, "Changing parameters" on page 10)

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2.2.6 Switching on the bias voltage of the photo diode

☝ Attention ☝

Before switching the bias voltage on make sure that the photodiode is poled correctly (inverse direction).
If the photodiode is forward biased with a voltage, a current will flow through it that could damage or even destroy it.

The bias voltage is switched on by setting the parameter:

BIA1 = ON for input 1

BIA2 = ON for input 2

in the channel menu of the module.

2.2.7 Setting the measurement range

Each input offers 7 measurement ranges.

Measurement range	Resolution	Accuracy
10 mA	0.1 µA	± 0.025 % f.s.
1 mA	10 nA	± 0.025 % f.s.
100 µA	1 nA	± 0.025 % f.s.
10 µA	0.1 nA	± 0.025 % f.s.
1 µA	10 pA	± 0.025 % f.s.
100 nA	1 pA	± 0.250 % f.s.
10 nA	0.1 pA	± 0.800 % f.s.

To set for example the measurement range to 1 mA full scale, enter

RNG1 =1.000mA for input 1

RNG2 =1.000mA for input 2

In the channel menu.

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2.2.8 Measuring the forward voltage (option PDA8000-FWD)

If the PDA8000 is used with the -FWD option the forward voltage (U_{FWD}) of the photodiode can be measured at input 1. The measurement current (I_{FWD}) used for measurement can be selected in the range of 0.01 mA to 10 mA and is set by the parameter:

Ifwd= 5.000mA

To measure the forward voltage (U_{FWD}) select:

MEASURE Ufwd!

Then press the soft key **CHANGE** twice to do a measurement. The measured voltage is displayed in the line **Ufwd=**

2.3 Display error messages

Possible reasons for error messages when try to change parameters:

NOT IF BIAS	Attempt to change the polarity of the photo diode, the measurement range or to start a forward voltage measurement, while a bias voltage is applied.
POLARITY !	Attempt to apply a the bias voltage with wrong polarity of the polarity of the photodiode.

Possible reasons for error messages during forward voltage measurement

ACCURACY !	Insufficient measurement accuracy (non-linearities or noise)
OVERFLOW !	The requested forward current could not be reached, even with the max. possible voltage. Possibly, no photo diode connected or bad connection.

.

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3 Communication with a control computer

3.1 General information

The description of the mainframe of the PRO8000 (-4) / PRO800 includes all instructions of how to prepare and execute the programming of the system via IEEE 488 or RS232C computer interface.

Special operation features of a PDA8000 photo current module are described here.

➔ (Refer to chapter 2, "Operating the PDA8000" starting on page 8)

NOTE

All analog values are read and written in SI units, i.e. A (not mA), W (not mW) etc. Letters may be written in small or capital letters.

3.1.1 Nomenclature

Program messages (PC ⇒ PRO8000 (-4)) are written in inverted commas:
"*IDN?"

Response messages (PRO8000 (-4) ⇒ PC) are written in brackets:
[:SLOT 1]

There is a decimal point: **1.234**

Parameters are separated with comma: **"PLOT 2,0"**

Commands are separated with semicolon: **"*IDN?;*STB?"**

3.1.2 Data format

According to the IEEE 488.2 specifications all data variables are divided into 4 different data formats:

Character response data (<CRD>)

Is a single character or a string. Examples:

A or **ABGRS** or **A125TG** or **A1.23456A**

➔ (Refer to IEEE488.2 (8.7.1))

Numeric response data Type 1 (<NR1>)

Is a numerical value with sign in integer notation. Examples:

1 or **+1** or **-22** or **14356789432**

➔ (Refer to IEEE488.2 (8.7.2))

Numeric response data Type 2 (<NR2>)

Is a numerical value with or without sign in floating point notation without exponent. Examples:

1.1 or **+1.1** or **-22.1** or **14356.789432**

➔ (Refer to IEE488.2 (8.7.3))

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Numeric response data Type 3 (<NR3>)

Is a numerical value with or without sign in floating point notation with exponent with sign . Examples:

1.1E+1 or **+1.1E-1** or **-22.1E+1** or **143.56789432E+306**

➔ (Refer to IEE488.2 (8.7.4))

3.2 Commands

3.2.1 Selecting the module slot

":SLOT <NR1>"	Selects a slot for further programming <Nr1>=1…8 (PRO8000), 1…2 (PRO800)
":SLOT?"	Queries the selected slot **[:SLOT <NR1><LF>]**

3.2.2 Selecting a port (PORT)

Programming:

":PORT 1"	Selects port 1 for further commands
":PORT 2"	Selects port 2 for further commands

Reading:

":PORT?"	Reads the selected port **[:PORT <NR1><LF>]**

3.2.3 Calibrating a photo diode (CALPD)

Programming:

":CALPD:SET <NR3>"	Programs the sensitivity (η) of the monitor diode in A/W

Reading:

":CALPD:SET?"	Reads the sensitivity (η) of the monitor diode in A/W **[:CALPD:SET <NR3><LF>]**
":CALPD:MIN?"	Reads the allowed minimum sensitivity (η) of the monitor diode in A/W **[:CALPD:MIN <NR3><LF>]**
":CALPD:MAX?"	Reads the allowed maximum sensitivity (η) of the monitor diode in A/W **[:CALPD:MAX <NR3><LF>]**

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3.2.4 Programming the forward current (IFWD)

NOTE

This command always affects port 1, so you do not need to select the port 1 first. This command is **only** available for a PDA8000 **with the option PDA8000-FWD**

Programming:

":IFWD:SET <NR3>"	Programs the forward current of port 1

Reading:

":IFWD:SET?"	Reads the forward current of port 1 **[:IFWD:SET <NR3><LF>]**
":IFWD:MIN?"	Reads the allowed minimum forward current of port 1 **[:IFWD:MAX <NR3><LF>]**
":IFWD:MAX?"	Reads the allowed maximum forward current of port 1 **[:IFWD:MIN <NR3><LF>]**

3.2.5 Reading the photo diode current (IPD)

NOTE

Please first select the desired port with the command ":PORT"

Programming:

":IPD:MEAS <NR1>"	Programs the photo current to be a measurement value for “ELCH” on output string position <NR1> (1...8)

Reading:

":IPD:ACT?"	Reads the actual photo diode current **[:IPD:ACT <NR3><LF>]**
":IPD:MIN_R?"	Reads I_{PD} – ADC = 0000 **[:IPD:MIN_R <NR3>]**
":IPD:MAX_R?"	Reads I_{PD} – ADC = FFFF **[:IPD:MAX_R <NR3>]**

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3.2.6 Switch the bias voltage on and off (PDBIA)

NOTE

Please first select the desired port with the command ":PORT"

☝ Attention ☝

Before switching the bias voltage on make sure that the photodiode is poled correctly (inverse direction).

If the photodiode is forward biased with a voltage, a current will flow through it that could damage or even destroy it.

Programming:

":PDBIA ON"	Switches the bias voltage on
":PDBIA OFF"	Switches the bias voltage off

Reading:

":PDBIA?"	Reads the bias voltage switch **[:PDBIA ON<LF>]** **[:PDBIA OFF<LF>]**

3.2.7 Select the photo diode polarity (PDPOL)

NOTE

Please first select the desired port with the command ":PORT"

Programming:

":PDPOL AG"	Selects anode on ground
":PDPOL CG"	Selects cathode on ground

Reading:

":PDPOL?"	Reads the monitor diode polarity **[:PDPOL AG<LF>]** **[:PDPOL CG<LF>]**

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3.2.8 Reading the optical power (POPT)

NOTE

Please first select the desired port with the command ":PORT"

Reading:

":POPT:ACT?"	Reads the actual optical power
	[:POPT:ACT <NR3><LF>]
":POPT:MIN_R?"	Reads P_{LD} – ADC = 0000
	[:POPT:MIN_R <NR3><LF>]
":POPT:MAX_R?"	Reads P_{LD} – ADC = FFFF
	[:POPT:MAX_R <NR3><LF>]

3.2.9 Selecting the measurement range (RANGE)

NOTE

Please first select the desired port with the command ":PORT"

Programming:

":RANGE 1"	Selects the 10 nA range
":RANGE 2"	Selects the 100 nA range
":RANGE 3"	Selects the 1 µA range
":RANGE 4"	Selects the 10 µA range
":RANGE 5"	Selects the 100 µA range
":RANGE 6"	Selects the 1 mA range
":RANGE 7"	Selects the 10 mA range

Reading:

":RANGE?"	Reads the selected range
	[:RANGE <NR1><LF>]

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3.2.10 Querying the module type

Reading:

":TYPE:ID? "	Reads the module ID (here 107) **[:TYPE:ID 107<LF>]**
":TYPE:SUB?	Reads module subtype: 0: 1-channel PDA, no U_{FWD} measurement 1: 2-channel PDA, no U_{FWD} measurement 2: 1-channel PDA, with U_{FWD} measurement 3: 2-channel PDA, with U_{FWD} measurement **[:TYPE:SUB <NR1><LF>]**

3.2.11 Programming the bias voltage (VBIAS)

Programming:

":VBIAS:SET <NR3>"	Programs the bias voltage
":VBIAS:START <NR3>"	Programs the bias voltage start for “ELCH”
":VBIAS:STOP <NR3>"	Programs the bias voltage stop for “ELCH”

Reading:

":VBIAS:SET?"	Reads the set bias voltage **[:VBIAS:SET <NR3><LF>]**
":VBIAS:MIN?"	Reads the allowed minimum set bias voltage **[:VBIAS:MIN <NR3><LF>]**
":VBIAS:MAX?"	Reads the allowed maximum set bias voltage **[:VBIAS:MAX <NR3><LF>]**
":VBIAS:MIN_W?"	Reads U_{BIAS} – DAC = 0000 **[:VBIAS:MIN_W <NR3><LF>]**
":VBIAS:MAX_W?"	Reads U_{BIAS} – DAC = FFFF **[:VBIAS:MAX_W <NR3><LF>]**
":VBIAS:START?"	Reads the start bias voltage for “ELCH” **[:VBIAS:START <NR3><LF>]**
":VBIAS:STOP?"	Reads the stop bias voltage for “ELCH” **[:VBIAS:STOP <NR3><LF>]**

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3.2.12 Reading the forward voltage (VFWD)

NOTE

This command always affects port 1, so you do not need to select the port 1 first. This command is **only** available for a PDA8000 **with the option PDA8000-FWD**

Reading:

":VFWD:ACT?"	Reads the actual laser voltage
	[:VFWD:ACT <NR3><LF>]
":VFWD:MIN_R?"	Reads U_{FWD} – ADC = 0000
	[:VFWD:MIN_R <NR3><LF>]
":VFWD:MAX_R?"	Reads U_{FWD} – ADC = FFFF
	[:VFWD:MAX_R <NR3><LF>]

NOTE

Before measuring the forward voltage, you should select a suited forward current with the command ":IFWD".

If the photo diode is poled wrong, you will measure a voltage of abt. 10V.

3.3 IEEE error messages of an PDA8000

[1401,"Attempt to switch on BIAS while photo current is negative"]

Possible reason: Wrong photo diode polarity

➔ (Refer to chapter 3.2.7, "Select the photo diode polarity (PDPOL)" on page 17)

[1402,"Attempt to change polarity while BIAS is on"]

Reason: The polarity of the photo diode can not be changed with bias on.

[1403,"Attempt to change measurement range while BIAS is on"]

Possible reason: The measurement range can not be changed with bias on.

[1404,"Attempt to measure U_{fwd} while BIAS is on"]

Possible reason: The forward voltage can not be measured with bias on.

[1405,"Ufwd measurement failed – accuracy error"]

Possible reason: Insufficient measurement accuracy due to non-linearities or noise.

[1406," Ufwd measurement failed – voltage overflow"]

Possible reason: The requested forward current could not be reached, even with the max. possible voltage. Possibly, no photo diode connected or bad connection..

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3.4 Status reporting

The PDA8000 has no own device error registers. You can only use the PRO8000 (-4) / PRO800 mainframe status registers shown here.

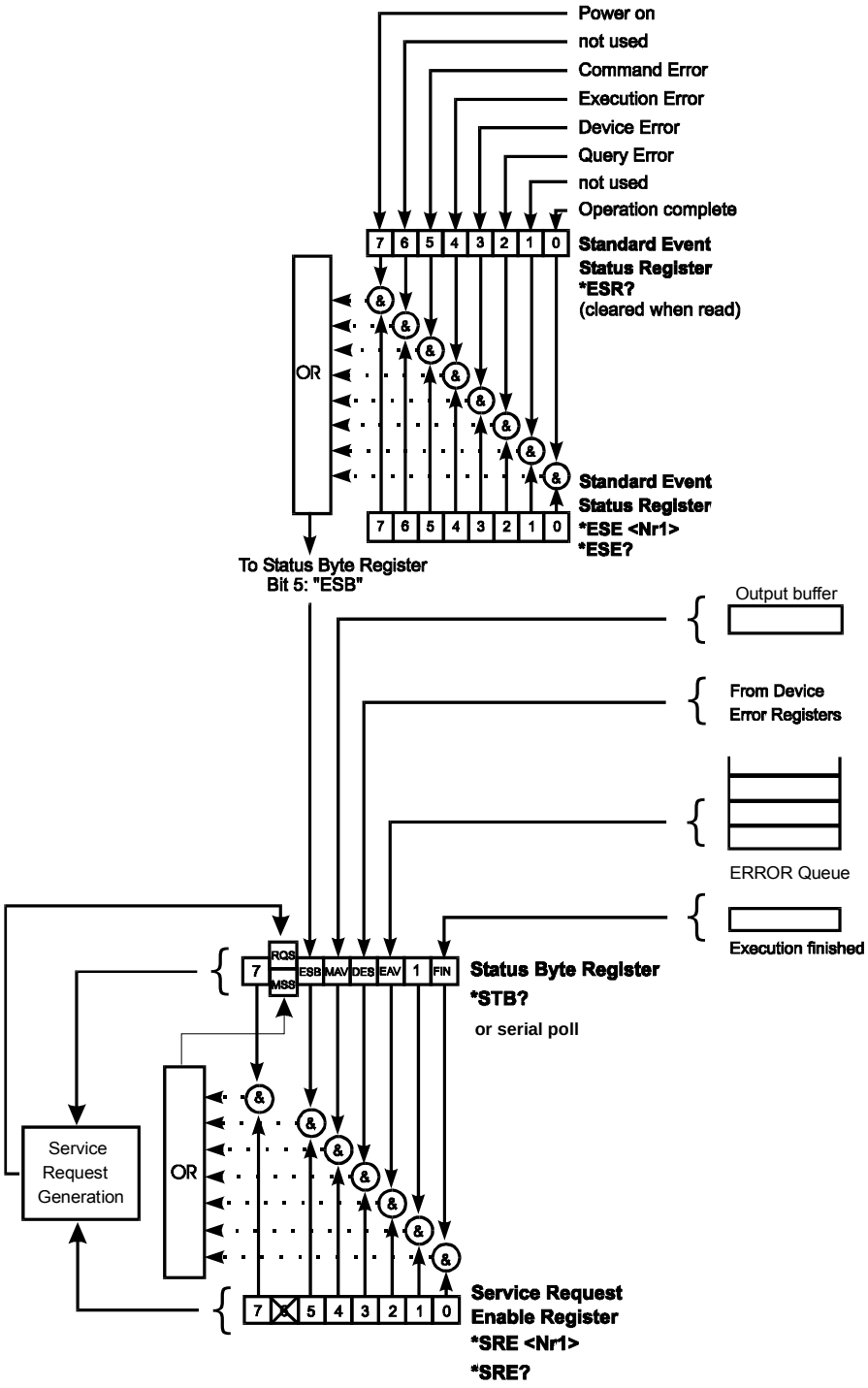

Figure 2 The PRO8000 (-4)/ PRO800 register ESR, ESE, STB and SRE

3.4.1 Standard event status register (ESR)

The bits of this register represent the following standard events:

Power on	This event bit indicates, that an off to on transition has occurred in the power supply. So it is high after turning on the device for the first time.
User request	(Not used)
Command error	A command error occurred.
Execution error	An execution error occurred.
Device dependent error	A device dependent error occurred.
Query error	A query error occurred.
Request control	(Not used)
Operation complete	Can be set with **"*OPC".**

The ESR can be read directly with the command **"*ESR?".** This read command clears the ESR. The content of the ESR can not be set.

The bits are active high.

3.4.2 Standard event status enable register (ESE)

The bits of the ESE are used to select, which bits of the ESR shall influence bit 5 (ESB) of the STB. The 8 bits of the ESE are combined with the according 8 bits of the ESR via a wired “AND”-function. These 8 results are combined with a logical “OR”-function, so that any "hit" leads to a logical 1 in bit 5 (ESB) of the STB. As any bit of the STB can assert an SRQ, every event (bit of the ESR) can be used to assert an SRQ.

3.4.3 Status byte register (STB)

The bits of this register are showing the status of the PRO8000 (-4) / PRO800.

RQS	RQS: Request service message: Shows, that this device has asserted SRQ (read via serial poll).
MSS	Master summary status: Shows that this device requests a service (read via **"*STB?"**).
MAV	(Message AVailable) This bit is high after a query request, as a result "waits" in the output queue to be fetched. It is low, if the output queue is empty.
DES	(Device Error Status) This bit is high after a device error occurred. Which device errors will set this bit is defined with the EDE.
EAV	(Error AVailable) This bit is high as long as there are errors in the error queue.
FIN	(command FINished) This bit is high, after a command has finished and all bits of the STB have been set.

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The STB can be read directly with the command **"*STB?".** The content of the STB can not be set. The bits are active high.

All bits except bit 6 of the STB can be used to assert a service request (SRQ)
➔ (Please refer to 3.4.5). Alternatively the SRQ can be recognized using the command **"*STB?"** (Please refer to 3.4.6) or by serial poll (Please refer to 3.4.7).

3.4.4 Service request enable register (SRE)

The bits of the SRE are used to select, which bits of the STB shall assert an SRQ.

Bit 0, 1, 2, 3, 4, 5 and 7 of the STB are related to the according 7 bits of the SRE by logical “AND”. These 7 results are combined by a logical "OR", so that any "hit" leads to a logical 1 in bit 6 of the STB and asserts an SRQ.

3.4.5 Reading the STB by detecting SRQ

If an SRQ is asserted (see 3.4.4) bit 6 of the STB is set to logical 1, so that the controller can detect which device asserted the SRQ by auto serial polling.

3.4.6 Reading the STB by "*STB?" command

If the controller does not "listen" to SRQ’s at all, the service request can be detected by reading the status byte with the command **"*STB?".**

If bit 6 is logical 1, a service request was asserted.

3.4.7 Reading the STB by serial poll

If the controller does not support auto serial poll, the service request can also be detected via manual serial poll.

If bit 6 is logical 1, a service request was asserted.

4 Service and Maintenance

4.1 General remarks

The PDA8000 modules don't need any maintenance by the user.

In order to ensure best performance, accuracy and reliable operation, Thorlabs recommends a **recalibration cycle of 24 months.**

4.2 Troubleshooting

In case that one module of your PRO8000 (-4) / PRO800 system shows malfunction please check the following items:

- Module does not work at all (no display on the mainframe):
  - Mainframe PRO8000 (-4) / PRO800 connected properly to the mains?
    - Connect the PRO8000 (-4) / PRO800 to the power line, take care of the right voltage setting of your mainframe.
  - Mainframe PRO8000 (-4) / PRO800 turned on?
    - Turn on your PRO8000 (-4) / PRO800 with the key mains-switch.
  - Control the fuse at the rear panel of the PRO8000 (-4) / PRO800 mainframe.
    - If blown up, replace the fuse by the correct type

  ➔ (refer to your PRO8000 (-4) / PRO800 mainframe operating manual to select the appropriate fuse)

- The PRO8000 (-4) / PRO800 display works, but not the module:
  - Is the module inserted correctly and are all mounting screws tightened?
    - Insert the module in the desired slot and tighten all mounting screws properly.

- You don't measure the right photo current
  - Is the photo diode connected properly?
    - Check the connecting cable.
  - Is the photo diode poled correctly?
    - If not, change the polarity with the **":PDPOL "** command or in the channel menu.
  - Do you use a bias voltage with the photo diode in photocurrent mode?
    - Turn off bias voltage in the channel menu, with the **":PDBIA OFF"** command or change the polarity of the diode for photo element mode.

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- Is the bias voltage set to 0 in photo-element mode?
  - Enter an appropriate bias voltage with the command **":VBIAS:SET <NR3>",** or in the channel menu**.**

- Is the correct photo diode efficiency η set (A/W)?
  - Enter the coefficient in the channel menu or with the command: **":CALPD:SET <NR3>"**

- Do you have chosen an appropriate measurement range for your application?
  - Use the command **":RANGE <NR1>"** or use the channel menu to select a higher or lower sensitivity

If this does not help to resolve your trouble, please contact Thorlabs' Tech Support. (refer to section 5.6, "

Addresses ” on page 35

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5 Appendix

5.1 Warranty

Thorlabs warrants material and production of the PDA8000 modules for a period of 24 months starting with the date of shipment. During this warranty period *Thorlabs* will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to *Thorlabs (Germany)* or to a place determined by *Thorlabs*. The customer will carry the shipping costs to *Thorlabs*, in case of warranty repairs *Thorlabs* will carry the shipping costs back to the customer.

If no warranty repair is applicable the customer also has to carry the costs for back shipment.

In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs warrants the hard- and software determined by *Thorlabs* for this unit to operate fault-free provided that they are handled according to our requirements. However, *Thorlabs* does not warrant a faulty free and uninterrupted operation of the unit, of the soft- or firmware for special applications nor this instruction manual to be error free. *Thorlabs* is not liable for consequential damages.

Restriction of warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient conditions (refer to the PRO8000 (-4) / PRO800 mainframe operation manual) stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. *Thorlabs* does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs reserves the right to change this instruction manual or the technical data of the described unit at any time.

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5.2 Thorlabs “End of Life” policy (WEEE)

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see Figure 3)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

5.2.1 Waste treatment on your own responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

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5.2.2 Ecological background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of live products will thereby avoid negative impacts on the environment.

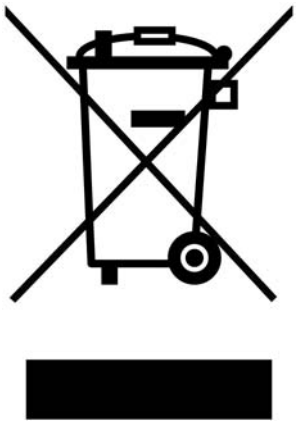

Figure 3 Crossed out “wheelie bin” symbol

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List of abbreviations

The following abbreviations are used in this manual:

ADC	Analog to Digital Converter
AG	Anode Ground
CG	Cathode Ground
CLR	CLeaR
CR	Carriage Return
CRD	Character Response Data
DAC	Digital to Analog Converter
DC	Direct Current
DCL	Device Clear
EAV	Error AVailable
ELCH	ELectrical Characterization
EOI	End Of Information
ESE	Standard Event Status Enable register
ESR	Event Status Register
FIN	Command FINished
GET	Group Execute Trigger
GTL	Go To Local
IEEE	Institute for Electrical and Electronic Engineering
LD	Laser Diode
LF	Line Feed
LLO	Local Lockout
NR1	Numeric Response data of type 1
NR2	Numeric Response data of type 2
NR3	Numeric Response data of type 3
MAV	Message AVailable)
MSS	Master Summary Status
PC	Personal Computer
PD	Photo Diode
RQS	ReQuest Service Message
SDC	Selected Device Clear
SEL	SELect
SRE	Service Request Enable Register
SRQ	Service ReQuest
STB	STatus Byte Register
TRG	TRiGger

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5.4 Certifications and compliances

Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A Radiated and Conducted Emissions[1,2,3] and Immunity.[1,2,4]
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance criterion C)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance criterion B)
	IEC 61000-4-4	Electrical Fast Transient / Burst Immunity (Performance criterion C)
	IEC 61000-4-5	Power Line Surge Immunity (Performance criterion C)
	IEC 61000-4-6	Conducted RF Immunity (Performance criterion B)
	IEC 61000-4-11	Voltage Dips and Interruptions Immunity (Performance criterion C)
	EN 61000-3-2	AC Power Line Harmonic Emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with the Radiocommunications Act and demonstrated per EMC Emission standard[1,2,3]:	
	AS/NZS 2064	Industrial, Scientific, and Medical Equipment: 1992
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B[1,2,3].	

[1] Compliance demonstrated using high-quality shielded interface cables.

[2] Compliance demonstrated with the PDA8000 series modules installed in the Thorlabs PRO8x series of mainframes.

[3] Emissions, which exceed the levels required by these standards, may occur when this equipment is connected to a test object.

[4] Minimum Immunity Test requirement.

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5.5 Copyright

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Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.

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5.6 Addresses

USA, Canada, and South America

Thorlabs, Inc.
435 Route 206
Newton, NJ 07860
USA
Tel: 973-579-7227
Fax: 973-300-3600
www.thorlabs.com
www.thorlabs.us (West Coast)
Email: sales@thorlabs.com
Support: techsupport@thorlabs.com

Europe

Thorlabs GmbH
Hans-Böckler-Str. 6
85221 Dachau
Germany
Tel: +49-8131-5956-0
Fax: +49-8131-5956-99
www.thorlabs.de
Email: europe@thorlabs.com

France

Thorlabs SAS
109, rue des Côtes
78600 Maisons-Laffitte
France
Tel: +33-970 444 844
Fax: +33-811 38 17 48
www.thorlabs.com
Email: sales.fr@thorlabs.com

Japan

Thorlabs Japan, Inc.
Higashi Ikebukuro
Q Building 1st Floor 2-23-2
Toshima-ku, Tokyo 170-0013
Japan
Tel: +81-3-5979-8889
Fax: +81-3-5979-7285
www.thorlabs.jp
Email: sales@thorlabs.jp

UK and Ireland

Thorlabs Ltd.
1 Saint Thomas Place, Ely
Cambridgeshire CB7 4EX
Great Britain
Tel: +44-1353-654440
Fax: +44-1353-654444
www.thorlabs.com
Email: sales.uk@thorlabs.com
Support: techsupport.uk@thorlabs.com

Scandinavia

Thorlabs Sweden AB
Mölndalsvägen 3
412 63 Göteborg
Sweden
Tel: +46-31-733-30-00
Fax: +46-31-703-40-45
www.thorlabs.com
Email: scandinavia@thorlabs.com

China

Thorlabs China
Room A101, No. 100
Lane 2891, South Qiliashan Road
Putuo District
Shanghai
China
Tel: +86-21-60561122
Fax: +86-21-32513480
www.thorlabs.hk
Email: chinasales@thorlabs.com

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